IN THE CLAIMS:

Please cancel Claims 4 to 12, 16, 19 to 56 and 66 without prejudice to or disclaimer of the subject matter recited therein.

Please amend Claims 1 to 3, 13 to 15, 17, 18, 57 to 59 and 61 to 65, and add new Claims 67 to 93 to read as follows. A marked-up copy of Claims 1 to 3, 13 to 15, 17, 18, 57 to 59 and 61 to 65, showing the changes made thereto, is attached. Note that all claims currently pending in this application, including those not presently being amended, have been reproduced below for the Examiner's convenience.

1. (Amended) A vibration member comprising:

an elastic member including a driving portion: and

an electro-mechanical energy conversion element in contact with said elastic member, said electro-mechanical energy conversion element having a plurality of electrodes formed by a polarization process of said electro-mechanical energy conversion element, and a modulus of elasticity profile generated by the polarization process, where application of an alternating signal to said electro-mechanical energy conversion element generates a plurality of vibrations in said elastic member, and where a combination of the plurality of vibrations generates a driving vibration in said driving portion,

wherein a rigidity of a portion of said elastic member located between said plurality of electrodes is set larger than a rigidity of other portions of said elastic member so as to offset differences in the modulus of elasticity profile generated by the polarization process of said electro-mechanical energy conversion element.

2. (Amended) A vibration member comprising:

an elastic member including a driving portion; and

an electro-mechanical energy conversion element in contact with said elastic member, said electro-mechanical energy conversion element having a plurality of electrodes formed by a polarization process of said electro-mechanical energy conversion element, and a modulus of elasticity profile generated by the polarization process, where application of an alternating signal to said electro-mechanical energy conversion element generates a plurality of vibrations in said elastic member, and where a combination of the plurality of vibrations generates a driving vibration in said driving portion,

wherein a cross-sectional area of a portion of said elastic member located between said plurality electrodes is set larger that a cross-sectional area of other portions of said elastic member so as to offset differences in the modulus of elasticity profile generated by the polarization process of said electro-mechanical energy conversion element.

3. (Amended) A vibration member comprising:

an elastic member including a driving portion; and

an electro-mechanical energy conversion element in contact with said elastic member, said electro-mechanical energy conversion element having a plurality of electrodes formed by a polarization process of said electro-mechanical energy conversion element, and a modulus of elasticity profile generated by the polarization process, where application of an alternating signal to said electro-mechanical energy conversion element generates a plurality of vibrations in said elastic member, and where a combination of the plurality of vibrations generates a driving vibration in said driving portion,

wherein a density of a portion of said elastic member located between said plurality of electrodes is set higher than a density of other portion of said elastic member so as to offset differences in the modulus of elasticity profile generated by the polarization process of said electro-mechanical energy conversion element.

Sub B1 cont.

13. (Amended) A vibration member having an annular or disc shape, comprising:

an elastic member including a driving portion, and having an annular or disc shape; and

A1 Cont.

an electro-mechanical energy conversion element having an annular shape and bonded to one surface of said elastic member, said electro-mechanical energy conversion element having a plurality of electrodes formed by a polarization process of said electro-mechanical energy conversion element, and a modulus of elasticity profile generated by the polarization process, where application of an alternating signal to the electro-mechanical energy conversion element generates a plurality of vibrations in said elastic member, and where a combination of the plurality of vibrations generates a driving vibration in said driving portion,

wherein a rigidity of a portion of said elastic member located between said plurality of electrodes is set larger than a rigidity of other portion of said elastic member so as to offset differences in the modulus of elasticity generated by the polarization process of said electro-mechanical energy conversion element.

14. (Amended) A vibration member having an annular or disc shape, comprising:

an elastic member including a driving portion, and having an annular or disc shape; and

an electro-mechanical energy conversion element having an annular shape and bonded to one surface of said elastic member, said electro-mechanical energy conversion element having a plurality of electrodes formed by a polarization process of said electro-mechanical energy conversion element, and a modulus of elasticity profile generated by the polarization process, where application of an alternating signal to said electro-mechanical energy conversion element generates a plurality of vibrations in said elastic member, and where a combination of the plurality of vibrations generates a driving vibration in said driving portion,

wherein a cross-sectional area of a portion of said elastic member located between said plurality of electrodes is set larger than a cross-sectional area of other portions of said elastic member so as to offset differences in the modulus of elasticity profile generated by the polarization process of said electro-mechanical energy conversion element.

15. (Amended) A vibration member having an annular or disc shape, comprising:

an elastic member including a driving portion, and having an annular or disc shape; and

an electro-mechanical energy conversion element having an annular shape and bonded to one surface of said elastic member, said electro-mechanical energy conversion element having a plurality of electrodes formed by a polarization process of said electro-mechanical energy conversion element, and a modulus of elasticity profile generated by the polarization process, where application of an alternating signal to the electro-mechanical energy conversion element generates a plurality of vibrations in said elastic member, and where a combination of the plurality of vibrations generates a driving vibration in said driving portion,

wherein a density of a portion of said elastic member located between the plurality of electrodes is set higher than a density of other portions of said elastic member so as to offset differences in the modulus of elasticity profile generated by the polarization process of said electro-mechanical energy conversion element.

17. (Amended) A vibration member comprising:

an elastic member including plural elastic member portions and a driving portion; and

an electro-mechanical energy conversion element held and fixed between said plural elastic member portions, said electro-mechanical energy conversion element having a plurality of electrodes formed by a polarization process of said electro-mechanical energy conversion element, and a modulus of elasticity profile generated by the polarization process, where application of an alternating signal to said electro-mechanical energy conversion element generates a plurality of vibrations in said elastic member, and

where a combination of the plurality of vibrations generates a driving vibration in said driving portion,

wherein a rigidity of a portion of said elastic member located between the plurality of electrodes polarized in directions different from each other is set larger than a rigidity of other portion of said elastic member so as to offset differences in the modulus of elasticity profile generated by the polarization process of said electro-mechanical energy conversion element.

18. (Amended) A vibration member comprising:

an elastic member including plural elastic member portions and a driving portion; and

an electro-mechanical energy conversion element held and fixed between said plural elastic member portions, said electro-mechanical energy conversion element having a plurality of electrodes formed by a polarization process of said electro-mechanical energy conversion element, and a modulus of elasticity profile generated by the polarization process, where application of an alternating signal to said electro-mechanical energy conversion element generates a plurality of vibrations in said elastic member, and where a combination of the plurality of vibrations generates a driving-vibration in said driving portion,

wherein a portion of said elastic member located between said plurality of electrodes polarized in directions different from each other is cut out so as to offset differences in the modulus of elasticity generated by the polarization process of said electro-mechanical energy conversion element.

57. (Amended) A vibration wave driving apparatus including said vibration member according to claim 1 and a contact member in press contact with said vibration member and movable relative to said vibration member by the driving force of said driving portion.

58. (Amended) A vibration wave driving apparatus including said vibration member according to claim 2 and a contact member in press contact with said vibration member and moveable relative to said vibration member by a driving force of said driving portion.

59. (Amended) A vibration wave driving apparatus including said vibration member according to claim 3 and a contact member in press contact with said vibration member and moveable relative to said vibration member by a driving force of said driving portion.

60. (Amended) A vibration wave driving apparatus including said vibration member according to claim 15 and a contact member in press contact with said vibration member and moveable relative to said vibration member by a driving force of said driving portion.

61. (Amended) A vibration wave driving apparatus including said vibration member according to claim 13 and a contact member in press contact with said

vibration member and moveable relative to said vibration member by a driving force of said driving portion.

Sub B1 cont.

62. (Amended) A vibration wave driving apparatus including said vibration member according to claim 14 and a contact member in press contact with said vibration member and moveable relative to said vibration member by a driving force of said driving portion.

AD Cont

63. (Amended) A vibration wave driving apparatus including said vibration member according to Claim 1 and a contact member in press contact with said vibration member through a fluid, said contact member being moveable relative to said vibration member by a driving force of said driving portion.

64. (Amended) A vibration wave driving apparatus including said vibration member according to Claim 13 and a contact member in press contact with said vibration member through a fluid, said contact member being moveable relative to said vibration member by a driving force of said driving portion.

65. (Amended) A vibration wave driving apparatus including said vibration member according to Claim 14 and a contact member in press contact with said vibration member through a fluid, said contact member being moveable relative to said vibration member by a driving force of said driving portion.

–67. (New) A vibration member according to Claim 1, wherein adjacent electrodes have different directions of polarization.

Sub B' Cont.

68. (New) A vibration member according to Claim 2, wherein adjacent electrodes have different directions of polarization.

69. (New) A vibration member according to Claim 3, wherein adjacent electrodes have different directions of polarization.

A3

70. (New) A vibration member according to Claim 1, wherein the plurality of electrodes are formed by polishing and dividing said electro-mechanical energy conversion element.

71. (New) A vibration member according to Claim 2, wherein the plurality of electrodes are formed by polishing and dividing said electro-mechanical energy conversion element.

72. (New) A vibration member according to Claim 3, wherein the plurality of electrodes are formed by polishing and dividing said electro-mechanical energy conversion element.

73. (New) A vibration member according to Claim 1, wherein said electro-mechanical energy conversion element is formed by a plurality of elements.

74. (New) A vibration member according to Claim 3, wherein said electro-mechanical energy conversion element is formed by a plurality of elements.

Sub B1 cont.

75. (New) A vibration member according to Claim 2, wherein said elastic member has a plurality of grooves for enlarging displacement of said driving portion, and a groove for enlarging displacement located between said plurality of electrode is set shallower than other of the plurality grooves for enlarging displacement.

B3 (cont.

76. (New) A vibration member according to Claim 3, wherein said elastic member is made of a material having pores, and a number of the pores in a portion of said elastic member located between said plurality of electrodes is set less than that in other portions of said elastic member.

77. (New) A vibration member according to Claim 3, wherein said elastic member is made of a material having pores, and the pores in a portion of said elastic member located between said plurality of electrodes are impregnated with a material having melting point which is lower than that of the other material of said elastic member.

78. (New) A vibration member according to Claim 13, wherein adjacent electrodes have different directions of polarization.

79. (New) A vibration member according to Claim 14, wherein adjacent electrodes have different directions of polarization.

80. (New) A vibration member according to Claim 15, wherein adjacent electrodes have different directions of polarization.

Sub B, cont.

81. (New) A vibration member according to Claim 13, wherein the plurality of electrodes are formed by polishing and dividing said electro-mechanical energy conversion element.

82. (New) A vibration member according to Claim 14, wherein the plurality of electrodes are formed by polishing and dividing said electro-mechanical energy conversion element.

C3 Cont

83. (New) A vibration member according to Claim 15, wherein the plurality of electrodes are formed by polishing and dividing said electro-mechanical energy conversion element.

84. (New) A vibration member according to Claim 13, wherein said electro-mechanical energy conversion element is formed by a plurality of elements.

85. (New) A vibration member according to Claim 15, wherein said electro-mechanical energy conversion element is formed by a plurality of elements.

86. (New) A vibration member according to Claim 14, wherein said elastic member has a plurality of grooves for enlarging displacement of said driving

portion, and a groove for enlarging displacement located between said electrodes is set shallower than other grooves for enlarging displacement.

Sub B, cont

87. (New) A vibration member according to Claim 15, wherein said elastic member is made of a material having pores, and a number of pores in a portion of said elastic member located between said plurality of electrodes is set less than that in other portions of said elastic member.

88. (New) A vibration member according to Claim 15, wherein said elastic member is made of a material having pores, and the pores in a portion of said elastic member located between said plurality of electrodes are impregnated with a material having a melting point which is lower than that of other material of said elastic member.

A3 cont

89. (New) A vibration member according to Claim 13, wherein said electro-mechanical energy conversion element has a plurality of electrodes provided in a peripheral direction, and a width in a radial direction of a portion between the plurality of electrodes is set larger than that of an electrode.

90. (New) A vibration member according to Claim 14, wherein said electro-mechanical energy conversion element has a plurality of electrodes provided in a peripheral direction, and a width in a radial direction of a portion between the plurality of electrodes is set larger than that of an electrode.

91. (New) A vibration member comprising:

an elastic member including a driving portion, and having an annular or disc shape; and

an electro-mechanical energy conversion element having an annular shape and bonded to one surface of said elastic member, said electro-mechanical energy conversion element having a plurality of electrodes formed by a polarization process of said electro-mechanical energy conversion element, and a modulus of elasticity profile generated by the polarization process, where application of an alternating signal to said electro-mechanical energy conversion element generates a plurality of vibrations in said elastic member, and a combination of the plurality of vibrations generates a driving vibration in said driving portion,

wherein a rigidity of a portion of said elastic member adjacent to a portion located between said plurality of electrodes is set larger than a rigidity of other portions of said elastic member so as to offset differences in the modulus of elasticity profile generated by the polarization treatment of said electro-mechanical energy conversion element.

92. (New) A vibration member comprising:

an elastic member including a driving portion, and having an annular or disc shape; and

an electro-mechanical energy conversion element having an annular shape and bonded to one surface of said elastic member, said electro-mechanical energy conversion element having a plurality of electrodes formed by a polarization process of said electro-mechanical energy conversion element, and a modulus of elasticity profile

generated by the polarization process profile, where application of an alternating signal to said electro-mechanical energy conversion element generates a plurality of vibrations in said elastic member, and a combination of the plurality of vibrations generates a driving vibration in said driving portion,

wherein a cross-sectional area of a portion of said elastic member adjacent to a portion located between said plurality of electrodes is set larger than that of other portions of said elastic member so as to offset differences in the modulus of elasticity generated by the polarization process of said electro-mechanical energy conversion element.

93. (New) A vibration member according to Claim 92, wherein said elastic member has a plurality of grooves for enlarging displacement of said driving portion, and a groove for enlarging displacement located between said plurality of electrodes is set shallower than other grooves for enlarging displacement.--

REMARKS

The claims now pending in the application are Claims 1 to 3, 13 to 15, 17, 18, 57 to 65 and 67 to 93, the independent claims being Claims 1 to 3, 13 to 15, 17, 18, 91 and 92. Claims 4 to 12, 19 to 56 and 66 have been cancelled. Claims 1 to 3, 13 to 15, 17, 18 and 57 to 65 have been amended.

In the Official Action dated August 2, 2001, Claims 1 to 66 were rejected under 35 U.S.C. § 102 (a), as anticipated by U.S. Patent No. 5,134,333 (Atsuta), U.S. Patent No. 5,298,829 (Tsukimoto) and U.S. Patent No. 5,300,850 (Okumura).

Reconsideration and withdrawal of the rejections respectfully are requested in view of the above amendments and the following remarks.

The rejections of the claims over the cited art respectfully are traversed. Nevertheless, without conceding the propriety of the rejections, Claims 4 to 12, 16 and 19 to 56 have been canceled and Claims 1 to 3, 13 to 15, 17, 18 and 57 to 65 have been amended more clearly to recite various novel features of the present invention, with particular attention to the Examiner's comments. Support for the proposed amendments may be found in the original application. No new matter has been added.

The present invention relates to a novel vibration wave driven motor. As described in greater detail in the present application, a modulus of longitudinal elasticity of a portion of the vibration modulus located between electrodes formed in an electro-mechanical energy conversion element is smaller than that of the electrode portion due to the influence of the polarization process if adjacent electrodes are polarized in opposite directions. In a case where adjacent electrodes are polarized in the same direction, since the thickness of the portion between the electrodes is thinner than that of other portions due to polishing, or if adjacent electrodes are respectively formed by distinct elements, than the modulus of longitudinal elasticity thereof also becomes smaller than in other portions. Differences in the modulus of elasticity causes unevenness of vibration and amplitude, and driving efficiency deteriorates.

The present invention, as recited in Claims 1 to 3 and 13 to 15, overcomes this drawback. In order to offset differences in the modulus of elasticity profile created by a polarization process of the electro-mechanical energy conversion element, the present invention discloses a vibration member in which 1) a rigidity of a portion of the elastic

member located between electrodes is set larger than a rigidity of other portions of the elastic member, 2) a cross-sectional area of a portion of the elastic member located between electrodes is set larger than the cross-sectional area of other portions of the elastic member, or 3) a density of a portion of the elastic member located between electrodes is set higher than the density of other portions of the elastic member. In this manner, unevenness of vibration and amplitude may be prevented.

In a vibration member in which an electro-mechanical energy conversion element is held and fixed between plural elastic member portions of an overall elastic member, the modulus of elasticity profile of the vibration member also varies due to a polarization process. As a result, vibration and amplitude between a bending vibration excited between electrodes of the same direction of polarization and a bending vibration excited between electrodes having opposite directions of polarization become uneven.

The present invention, as recited in Claim 17 and 18, overcomes this drawback. In order to offset differences in the modulus of elasticity profile generated by the polarization process, the vibration member is arranged such that 1) a rigidity of a portion of the elastic member located between electrodes having a different direction of polarization is set larger than the rigidity of other portions of the elastic member, or 2) a portion of the elastic member located between electrodes having a different direction of polarization is cut out.

Applicant submits that the prior art fails to anticipate the present invention. Moreover, Applicants submit that there are differences between the subject matter sought to be patented and the prior art, such that the subject matter taken as a whole would not have been obvious at the time the invention was made to one of ordinary skill in the art.

Each of the Atsuta '333 patent, the Tsukimoto '829 patent and the Okumura '850 patent discloses an elastic member having a portion in which a rigidity is different from that of other portions of the elastic member. However, Applicant submits that none of these references discloses or suggests at least the above described features of the present invention. Rather, each of these references discloses a portion having a rigidity different from the rigidity of other portions, where the different rigidity portion is provided every one half wavelength of a noise producing vibration. That is, each of the points of different rigidity is located at a harmonic node point so as to dampen or attenuate noise.

For the above reasons, Applicant submits that independent Claims 1 to 3, 13 to 15, 17 and 18 are allowable over the cited art.

Claims 57 to 65 depend from Claims 1 to 3, 13 to 15, 17 and 18, respectively, and are believed allowable for the same reasons. Moreover, each of these dependent claims recites additional features in combination with the features of its respective base claim, and is believed allowable in its own right. Individual consideration of the dependent claims respectfully is requested.

Newly presented Claims 67 to 93 have been added to provide Applicant with an additional scope of protection commensurate with the disclosure. No new matter has been added. Individual consideration of Claims 67 to 93 respectfully is requested.

Applicants believes that the present Amendment is responsive to each of the points raised by the Examiner in the Official Action, and submits that the application is in allowable form. Favorable consideration of the claims and passage to issue of the present application at the Examiner's earliest convenience earnestly are solicited.

Applicant's undersigned attorney may be reached in our Washington, D.C. office by telephone at (202) 530-1010. All correspondence should continue to be directed to our below listed address.

Respectfully submitted,

Attorney for Applicant

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